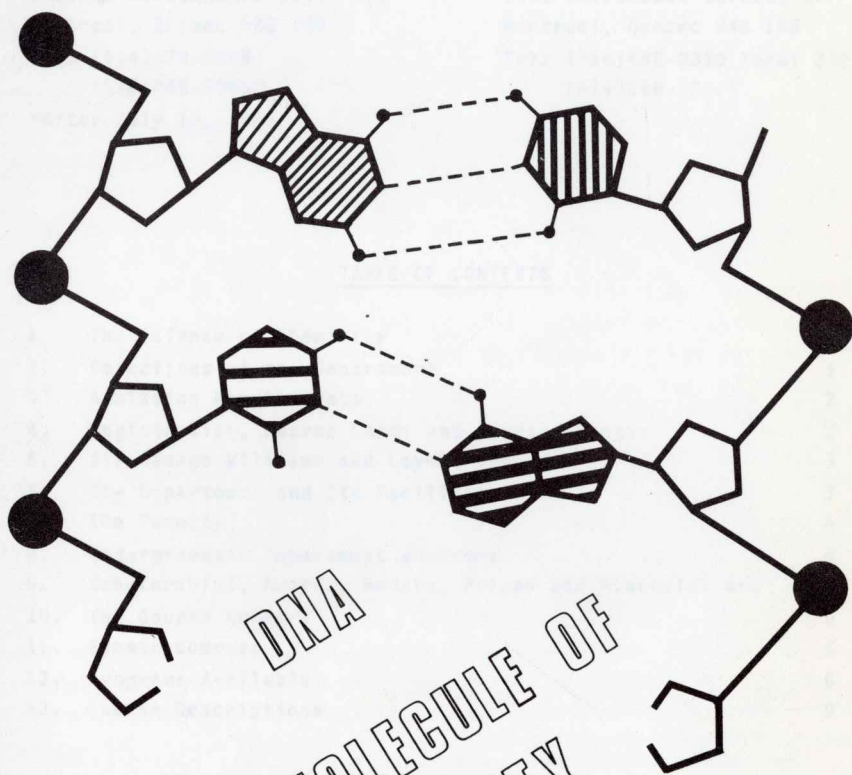




ARTS AND SCIENCE CHEMISTRY



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ATTACHED

CONCORDIA UNIVERSITY
DEPARTMENT OF CHEMISTRY
COURSE GUIDE
1985-86

LOYOLA AND SIR GEORGE WILLIAMS CAMPUSES

This guide has been prepared well in advance of the start of the academic year and the information contained in it is subject to change.

Students are advised not to purchase any texts before consulting the department or the professor concerned.

For more detailed information contact:

The Department of Chemistry

Sir George Williams Campus
1455 de Maisonneuve Blvd. W.,
Montreal, Quebec H3G 1M8
Tel: (514)879-5965
(514)848-3366*

Loyola Campus
7141 Sherbrooke Street, W.
Montreal, Quebec H4B 1R6
Tel: (514)482-0320 local 332
(514)848-3377*

*After July 15, 1985

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THE SCIENCE OF CHEMISTRY

"The study of chemistry is profitable, not only inasmuch as it promotes the material interests of mankind, but also because it furnishes us with insight into those wonders of creation which immediately surround us, and with which our existence, life and development are most clearly connected." Justus von Liebig (1851)

We live in a scientific age which is so profound that some believe "science" can ultimately answer all our questions and satisfy all our material needs. However, this knowledge developed by science must be carefully utilized to achieve a satisfying life.

Chemistry is one of the two most basic of the physical sciences (the other being physics) which most directly affects our everyday life. The chemist, like others in a rapidly expanding discipline, has found it necessary to specialize and therefore there are physical, organic, analytical, inorganic chemistry and biochemistry. Each chemist in being highly versed with the fundamentals of chemistry and the nature of the various branches within it, quickly recognizes the interdependence of each. Because of this, all discoveries and investigations have been the rewards of co-operative efforts between the various groups of chemists.

Our cover logo, the simplified and schematic partial structure of a nucleic acid called deoxyribonucleic acid (DNA), the molecule of heredity, was elucidated through the co-operation of all branches of chemistry. Biochemists isolated the compound, analytical chemists learned its composition, organic chemists studied the structure of components and synthesized models of it. The physical chemists elucidated the overall structure of this huge molecule, using physical methods like X-ray crystallography, and biochemists again studied its function in transmitting all hereditary properties of all living organisms from generation to generation. The importance of all this knowledge cannot be overestimated. The researcher, in close co-operation with his colleagues continues to establish the intricate details of the correlation between structure and function.

OBJECTIVES OF THE CHEMISTRY DEPARTMENT

The Chemistry Department aims to offer the best undergraduate education in chemistry whether it is for a student who is intending to be a specialist, who is taking courses in chemistry as a requirement of some other career or for general interest. The

faculty and facilities of the department are chosen with this aim in mind. Students are encouraged to meet individually with faculty members.

ADMISSION REQUIREMENTS

Students usually enter the first year of the 90-credit, 3 year program after completing the two year CEGEP program. These students are expected to have completed the "Science Profile" as established through joint action of the Quebec universities and the provincial Department of Education. This profile includes the following courses: Mathematics 103, 203, Physics 101, 201, 301; Chemistry 101, 201 and Biology 301. Graduates of the three year CEGEP technical program are also admissible.

Students from outside the province may also apply for admission. They may be admitted directly to the 90-credit program or to an extended credit undergraduate program depending upon the qualifications submitted. Consult the University Calendar for details.

Students who have not completed collegial studies and are over 21 years of age may apply for admission. Students who wish to use the alternative entry provisions should consult the "Mature Student Programs" in the University Calendar.

All students must make sure that they follow the requirements set out in their letter of admission.

REGISTRATION, COURSE LOADS AND COURSE CHANGES

Preregistration is handled by the student's home campus. Former students receive information from the Registrar's office concerning preregistration around the middle of March and may make appointments with the department advisors. New students will receive information about registration procedures around the end of March and then may arrange appointments with the department advisors.

The normal course load for a full time student is 30 credits for the academic year. It is the responsibility of the student to choose courses which meet the requirements of the chosen program. Students wishing to take a course overload must have the permission of the department and the Assistant Dean for Student Affairs of the Faculty of Arts and Science.

Make sure that you adhere to the deadlines for course changes and withdrawals as listed in the University Calendar. These changes

will only be recorded on your official records if the change forms are taken to the Registrar's office after completion by the department advisor.

SIR GEORGE WILLIAMS AND LOYOLA CAMPUSES

The department offers courses on both campuses. Some courses are offered on both campuses and others are offered on only one of the two.

Students are expected to choose one of the campuses as a "home campus" and it is assumed that students will do much of their early program on this campus. Students may register for sections of courses on either campus but must allow enough time to travel between campuses for various classes.

Courses on the Sir George Williams campus are designated by letters e.g., A, X, etc those on the Loyola campus by numbers e.g. 01, 51, etc.

THE CHEMISTRY DEPARTMENT AND ITS FACILITIES

There are 26 full-time faculty members in the department. In addition there is a variable number of adjunct professors and part-time lecturers involved in teaching. There are 18 support staff which includes technicians, secretaries, lab assistants, etc. The faculty covers the major areas of chemistry.

The department has teaching and research laboratories on both campuses but most of the research is done on the Sir George Williams campus where the major research instrumentation is located.

The department is the location of the Canadian Pico Second Laser Flash Photolysis Centre. Other major installations include a laser spectroscopy laboratory, x-ray diffraction and nuclear magnetic resonance facilities. The department makes extensive use of its micro processors.

The department offers graduate programs at the master's and doctoral levels. Full details of these may be found in the Graduate Faculty Calendar or obtained from the Graduate Program Director. Various members of the faculty are active in the following research areas: organic reaction mechanisms; NMR spectroscopy; flash photolysis; gas chromatography; mass spectrometry; x-ray crystallography; environmental chemistry and various aspects of biochemistry.

FACULTY

The faculty of the department consists of full-time and part-time members. The part-time faculty consists of well-qualified persons from industry or other institutions who teach a few courses or replace a regular faculty member who is on sabbatical leave for the year.

Chairman and Professor

C.H. Langford

D.E. McElcheran

R.H. Pallen

R.T.B. Rye

Professors

P.H. Bird

R.E. Townshend

L.D. Colebrook

G.J. Trudel

T. Nogrady

R.A. Westbury

N. Serpone

R.H. Zienius

O.S. Tee

Assistant Professors

J.R. Ufford

S.J. Daunt

R.H.C. Verschingel

G. Denes

A. English

ASSOCIATE PROFESSORS

T.J. Adley

J. Fraser

M. Baldwin

S. Shapiro

M. Doughty

Research Associates

K. Ekler

R. Le Van Mao

Z. Hamlet

D.K. Sharma

M.G. Hogben

M.J. Kornblatt

UNDERGRADUATE DEPARTMENT ADVISORS

The department has an advisor for undergraduates on each campus

On the Sir George Williams Campus the advisor is:

Dr. M.G. Hogben

Office H-1101-4 (Hall Bldg.)

Telephone: 879-8467 (After July 15, 1985: 848-3340)

On the Loyola campus the advisor is:

Dr. K. Ekler

Office DS-313 (Drummond Science Bldg.)

Telephone: 482-0320 local 284 (After July 15, 1985: 848-3372)

For both campuses the advisor in Biochemistry is:

Dr. J. Fraser

Office H-1101-2 (Hall Bldg.)

Telephone: 879-4128 (After July 15, 1985: 848-3339)

Cooperative Program Coordinator

Dr. R. Townshend

Office H-1141 (Hall Bldg.)

Telephone: 879-5963 (After July 15, 1985: 848-3349)

SCHOLARSHIPS, AWARDS, MEDALS, PRIZES AND FINANCIAL AID

A number of scholarships and prizes are available to students in Chemistry. Full details about these and other financial aid may be found in sections 17 and 18 of the University Calendar.

THE COURSE NUMBERS

Course numbers consist of three digits. The first digit is an indication of the level of the course. Two hundred level courses are normally taken during the first year and will have Chemistry 205 and 206 as prerequisites and possibly other 200 level courses. Three hundred level courses are normally taken during second year. These will have 200 level courses as prerequisites and possibly some at the 300 level. The 400 level courses are taken in the final year and will have 300 level courses as prerequisites. They may require some 400 level courses to be taken previously or concurrently.

Students are advised to watch the prerequisites carefully when planning their programs.

The second digit in the course number indicates a field of chemistry. A zero indicates a field of general interest, 1 designates analytical chemistry, 2 designates organic chemistry, 3 physical chemistry, 4 inorganic chemistry, 5 a research course, 7 biochemistry, 8 industrial or environmental chemistry and 9 instrumentation.

The third number in the numbering sequence is used to designate the different courses within a field. For example the number 231 would indicate the first course in physical chemistry at the introductory level.

SUMMER COURSES

The department offers courses during the summer session. There is no guarantee that any specific courses will be offered. In the past the courses which have been frequently offered are Chem. C205, C206, C221, C222, C231 and C232.

If spaces are available students may register for summer courses which are taught for students in the Cooperative program.

PROGRAMS AVAILABLE

Programs in chemistry have been designed to meet the specific needs of students. Programs are offered in chemistry, analytical chemistry and biochemistry. These are each offered at different levels. Students who intend to enter graduate school should register in the Honours program; those who intend to make a career in chemistry should register in the Specialization program; those who are in some other area but wish to have a good knowledge of chemistry should register in the Major program.

All of the above programs have a set of common core requirements of 45 credits. The Honours course consists of the same requirements as the Specialization courses except that students must take Chemistry C450 Research Project and Thesis and meet the University regulations concerning Honours degrees. The Specialization programs consist of additional credits beyond the core which are appropriate to the chosen field. On completion of a Specialization program, a graduate is eligible for membership in the Quebec Order of Chemists and thus is able to practice as a chemist. A working knowledge of French is required. The Major in Chemistry is essentially the core program.

Core Program in Chemistry (45 credits)

		Credits
Chem. C211	Introductory Analytical Chemistry	6
Chem. C221	Introductory Organic Chemistry I	3
Chem. C222	Introductory Organic Chemistry II	3
Chem. C231	Physical Chemistry I : Introduction	2
Chem. C233	Physical Chemistry II Spectroscopy & Quantum Theory	2
Chem. C241	Inorganic Chem. I: Introduction to Periodicity and Valence	3
Chem. C271	Introductory Biochemistry	3
Chem. C312	Intermediate Analytical Chemistry	3
Chem. C324	Organic Chemistry III: Organic Reactions	3
Chem. C325	Organic Chemistry IV: Organic Structure and Stereochemistry	3

Core Program (continued)

Chem. C331	Physical Chemistry III: Kinetics	2
Chem. C332	Physical Chemistry IV: Thermodynamics	2
Chem. C338	Physical Chemistry Laboratory I	2
Chem. C339	Physical Chemistry Laboratory II	2
and		
Chem. C242	Inorganic Chemistry II: Chemistry of the Main Group Elements	3
Chem. C341	Inorganic Chemistry III: The Transition Metals	3
or		
Chem. C374	Macromolecular Synthesis	3
Chem. C375	Intermediary Metabolism	

Specialization in Chemistry (60 credits)

Core		45
Math. C220	Mathematical Methods in Chemistry	3
Chem. C419	Independent Study and Practicum	
or		
Chem. C450	Research Project and Thesis	6
Additional credits in Chemistry in one area of concentration.		6

Specialization in Biochemistry (69-72 credits)

Core program		45
Biol. C260	Genetics	3
Biol. C270	Introductory Microbiology	3
Biol. C364	Cell Physiology	

Biochemistry Option

Chem. C479	Advanced Biochemistry Laboratory	3
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6 credits chosen from

Chem. C471	Enzyme Kinetics and Mechanism	
Chem. C473	Medicinal Chemistry I	
Chem. C474	Medicinal Chemistry II	6
Chem. C475	Pharmacology I	
Chem. C476	Pharmacology II	
Chem. C478	Hormone Biochemistry	
Chem. C498	Advanced Topics in Chemistry	

*400-level Chemistry course 3

400-level Biology course 3

* With departmental approval, these courses may be replaced
with Chem. C450 Research Project and Thesis.

Medicinal Chemistry Option

Chem. C479	Advanced Biochemistry Laboratory	3
Biol. C336		6
Chem. C473	Medicinal Chemistry I	3
Chem. C474	Medicinal Chemistry II	3
Chem. C475	Pharmacology I	3
or		
Chem. C476	Pharmacology II	

<u>Specialization in Analytical Chemistry (63-64 credits)</u>		<u>Credits</u>
Core Program		45
Chem. C290	Laboratory Automation & Data Handling	3
Chem. C311	Introductory Analytical Organic Chemistry	2
Chem. C316	Introductory Analytical Organic Laboratory	1
Chem. C390	Introductory Instrumentation	2
and		
Chem. C397	Introductory Instrumentation Laboratory	1
or		
Phys. C295	Experimental Electronics I	2
and		
Phys. C296	Experimental Electronics II	2
Chem. C398	Selected Topics in Chemistry	
or		3
Chem. C498	Advanced Topics in Chemistry (topic must be in Analytical Chemistry)	3
Chem. C419	Independent Study and Practicum	
or, with permission		6
Chem. C450	Research Project and Thesis	

Honours in Chemistry (60 credits)

One of the Specialization programs with the inclusion of Chemistry C450 Research Project and Thesis.

Major in Chemistry

Core Program. With the previous approval of the Department Advisor, substitutions in related fields up to a maximum of 9 credits may be permitted.

Major in Biochemistry

Core program without Chem. C312, C332, C338, C339 which are replaced with 9 credits chosen from Chem. C479, Biol. C260, C270, C364.

In conjunction with the Geology department, a joint specialization in Geology and Chemistry is offered. For details, see the University Announcement Section 31.140.

THE CHEMISTRY CO-OPERATIVE PROGRAM

The Co-operative program in Chemistry has the same course requirements as the various specialization programs but students alternate the academic session with industrial work sessions. Students interested should refer to the announcement in the University Calendar. Further information may also be obtained from the Principal, Institute for Co-Operative Education, 7141 Sherbrooke St. West, Montreal, Que. H4B 1R6 or from Dr. R. Townshend on the Sir George Williams Campus (telephone 879-5963 or after July 15, 1985, 848-3349)

Students who wish to have a knowledge of chemistry combined with other disciplines may register for a major or minor in chemistry. These options do not provide sufficient depth in chemistry to pursue a career in chemistry. The minor consists of 24 credits chosen to form a coherent pattern which complements the students other areas of study. This chosen pattern must have been previously approved by a Departmental program advisor.

Certificate in Scientific Measurement (Chemistry Option)(33 credits)

A program in scientific measurements with a chemistry option is available. This program is designed to meet very specific needs and requires 33 credits with the following courses:

Chem. C211, C310, C314, C315, C319, C390, C397, C490, C497
Phys. C295, C296, C396, C397

Students may transfer into the program up to twelve credits earned in an incomplete degree or certificate program or as an independent student provided they are students in good standing. The credits which are transferred are determined by the University at the point of entry into the program.

COURSE DESCRIPTIONS

The information in this section is correct up to the time this booklet went to press. Students are cautioned against buying texts, references, etc., before hearing from the instructor. Instructors may change depending upon scheduling problems which arise when timetables are completed.

Chemistry C205 General Chemistry I 3 credits

Instructors: G. Trudel, J. Ufford

Prerequisites: none

For: Students who have not taken CEGEP level chemistry, students who wish to obtain some knowledge of chemistry or to continue in chemistry. This course, together with Chem. C206, is a prerequisite for all other courses in chemistry except Chem. C208. Students in programs leading to the B.Sc. degree may not take this course for credits to be applied to their program of concentration.

Format: Lectures and Laboratories

Basis of Grading: Combination of tests, laboratory work and final exam.

Text: Petrucci: General Chemistry (3rd Ed.) MacMillan.

Description: This course is intended to provide students with a knowledge of basic concepts in chemistry. Among the topics discussed are stoichiometry; states of matter, atomic and molecular structure, the periodic table and periodicity and chemical bonding.

Chemistry C206 General Chemistry II 3 credits

Instructor: G. Trudel, J. Ufford

Prerequisites: Chemistry C205

For: Same as Chemistry C205

Format: Lectures and Laboratories

Basis of Grading: Combination of tests, laboratory work and final exam.

Text: Petrucci: General Chemistry (3rd Ed.) MacMillan

Description: Thermochemistry, solutions and their properties, equilibrium, ionic equilibrium, pH, buffers, kinetics, reaction mechanisms, other selected topics related to biochemistry, biology, and engineering.

Chemistry C208 Chemistry for Non-Science Students 3 credits

Instructor: M. Hogben

Prerequisites: none

For: Students not registered for a B.Sc.

Format: Lectures

Basis of grading: Term paper, weekly tests or midterm test, final exam.

Texts: Meyer: Chemistry of Hazardous Materials (Prentice-Hall)

Garve, Reid, Robertson: Core Chemistry (Oxford)

Description: This course covers aspects of chemistry which are of general interest to the non-science student. Sections deal with the social impact of chemistry and with chemistry of the natural environment.

Chemistry C211 Introductory Analytical Chemistry 6 credits

Instructor: A. English, R. Zienius

Prerequisites: CEGEP Chem. C201, Phys. C301, Math. C103, C203 or equivalent.

For: All degree programs in chemistry and certificate in measurement.

Format: Lectures and laboratory.

Basis of Grading: Class tests, final exam, lab work.

Text: Christian: Analytical Chemistry (3rd Ed.) Wiley

Description: Treatment of analytical data; chemical equilibria as applied to volumetric and gravimetric procedures; general theory of titrations and titration curves; neutralization,

precipitation, complexation, oxidation-reduction, and non-aqueous titrations; gravimetric analysis; potentiometry and potentiometric titrations; molecular and atomic absorption methods; gas chromatography. Laboratory is taken concurrently and provides experience in the techniques of analysis discussed in the lectures.

Chemistry C221 Introductory Organic Chemistry I 3 credits

Instructors: M. Baldwin, M. Doughty, and Z. Hamlet

Prerequisites: Chemistry C206 or equivalent

For: All programs in Chemistry.

Format: Lectures and laboratory.

Basis of Grading: Midterm and final exams, laboratory work.

Text: Fessenden and Fessenden: Organic Chemistry (Willard Grant)

Description: Basic aspects of orbitals and their role in covalent bonding. Acids and bases. Delocalization of electrons.

Alkanes, their structures, isomerism and nomenclature.

Introductory stereochemistry. Enantiomers, diastereomers, conformers, Fischer projections, Cahn-Ingold-Prelog sequence rules for specification of chirality. E/Z-isomerism.

Conformations of cyclic compounds. Alkyl halides, S_N1 , S_N2 , $E1$, $E2$ reactions, their mechanisms and stereochemistry.

Free-radical reactions, organometallic compounds. Chemistry of alcohols, ethers and related compounds.

Chemistry C222 Introductory Organic Chemistry II 3 credits

Instructors: M. Baldwin, M. Doughty and Z. Hamlet

Prerequisites: Chem. C221 or equivalent

For: All degree programs in Chemistry.

Format: Lectures and laboratory

Basis of Grading: Laboratory work, midterm and final exams.

Text: Fessenden and Fessenden; Organic Chemistry (Willard Grant)

Description: Introduction to the use of IR and NMR spectroscopy for identification of simple organic compounds. Chemistry of

alkenes, alkynes and dienes. Electrophilic additions, Markovnikov's rule, conjugate additions, Diels-Alder reaction, polymerization. Benzenes, Huckel rule and aromaticity.

Electrophilic aromatic substitution, its mechanism and orientation. Chemistry of aldehydes and ketones. Reduction, Wittig, and Grignard reactions. Aldol condensation.

Chemistry of carboxylic acids and their derivatives.

Chemistry of amines. Simple reaction mechanisms.

Chemistry C231 Physical Chemistry I: Introduction 3 credits

Instructors: S. Daunt, K. Ekler, R. Rye, R. Townshend, R. Westbury

Prerequisites: CEGEP Chem. 201, Physics 301, Math 103, 203 or equivalent

For: All degree programs in chemistry

Format: Lectures

Basis of Grading: Midterm and final exams

Text: Laidler and Meiser: Physical Chemistry (Benjamin)

Description: First law of thermodynamics, thermochemistry, entropy, the second and third laws of thermodynamics, free energy and chemical equilibrium, electrochemical cells and the Nernst equation, the Gibbs-Helmholtz equation. Applications of thermodynamics to systems of chemical interest.

Chemistry C233 Physical Chemistry II Spectroscopy and Quantum Theory 2 credits

Instructor: TBA

Prerequisites: CEGEP Chemistry 201, Physics 301 or equivalent and Math 220

For: All degree programs in Chemistry

Format: Lectures

Basis of grading: TBA

Text: TBA

Description: This course is intended to introduce the student to the basic ideas of quantum mechanics, spectroscopy and the electronic structure of atoms and molecules. Topics covered include the origins and postulates of quantum theory; applications to simple systems; the hydrogen atom; the aufbau principle of the elements; simple molecules. Spectroscopy and spectroscopic measurements; simple atomic spectra; infra-red and Raman spectra of simple molecules, fluorescence, N.M.R.

Chemistry C241 Inorganic Chemistry I: Introduction to Periodicity and Valence Theory 3 credits

Instructors: P. Bird, N. Serpone, R.H. Pallen

Prerequisites: CEGEP Chem. 201, Physics 301, Math 103, 203 or equivalent.

For: All degree programs in Chemistry

Format: Lectures, problem sessions and laboratory

Basis of Grading: Assignments, midterm and final exams

Text: Huheey: Inorganic Chemistry (Harper and Row)

Description: The structure of the atom, covalent bonding, chemical forces, complex ions, crystal field theory. Bonding theories of metals and semi conductors.

Chemistry C242 Inorganic Chemistry II. Chemistry of
the Main Group Elements

3 credits

Instructors: P. Bird, R. Pallen

Prerequisites: CEGEP Chem. 201, Phys. 301, Math 103, 203 or
equivalent

For: All degree programs in Chemistry except Biochemistry

Format: Lectures and laboratory

Basis of Grading: Assignments, midterm and final exams

Text: Lajowski: Modern Inorganic Chemistry (Dekker)

Description: A survey of the properties and reactions of:

Hydrogen, Group IA (Lithium to Cesium) and Group IIA
(Beryllium to Radium): Ionic bonding, Boron, Group IIIANitrogen, Group VB (Phosphorus to Bismuth), Oxygen, Group VIB
(Sulphur to Polonium), the Halogens, the Noble gases, Group
IIB (Zinc, Cadmium and Mercury).

Chemistry C271 Introductory Biochemistry

3 credits

Instructor: TBA

Prerequisite: Chem. C222

For: All programs in Chemistry

Format: Lectures and laboratory

Basis of Grading: TBA

Text: TBA

Description: This course is an introduction to the essentials of
biochemistry. Topics discussed are protein structure,
enzymology, carbohydrate metabolism and its regulation; an
overview of bioenergetics, nucleic acids and protein
biosynthesis. Students who have received credit for Chem C372
may not take this course for credit.

Chemistry C290 Laboratory Automation and Data Handling.

3 credits

Instructor: R. Westbury, P.H. Bird

Prerequisites: Comp. C211 or equivalent, Chem. C211 previously or
concurrently and permission of the department

For: Specialization in Analytical Chemistry

Format: Lectures, tutorials and laboratory

Basis of Grading: Laboratory work, midterm and final exams

Description: Introduction to some modern techniques used to
transduce and manipulate raw chemical data. Topics to be
discussed will include: statistical treatment of chemical

data, using programs written in Basic, or other high-level language; the use of binary, decimal, and hexadecimal numbers; programming a single-board computer or modern microcomputer using machine and assembly languages; input-output operations; elementary interfacing techniques. Experiments will involve the collection and treatment of data for common laboratory instruments such as electrodes and photodetectors.

Chemistry C298 Selected Topics in Chemistry 3 credits
Details not yet available.

Chemistry C299 Selected Topics in Chemistry 6 credits
Details not yet available.

Chemistry C302 Industrial Chemistry, Resources and Environment 2 credits

Instructor: R. Pant

Prerequisites: Student must be registered in a program in chemistry and be within 42 credits of graduation or permission of the department.

For: Optional Course

Format: Lectures

Basis of Grading: Tests and final exam.

Text: TBA

Description: An introduction to chemical engineering for chemists. Management and conservation of resources; pollution control; occupational and environmental health; technological and environmental impact assessment.

Chemistry C303 Chemical Technology and Human Values 2 credits
Instructor: TBA

Prerequisites: Student must be registered in a chemistry program and be within 42 credits of graduation or permission of the department

For: Optional course

Format: Lectures

Basis of Grading: TBA

Text: TBA

Description: The history of technology: the impact of chemistry on material life; appropriate technologies; chemistry and war; the social responsibility of the scientist.

Chemistry C310 Instrumental Analysis II: Electrochemical
and Separation Methods 2 credits

Instructor: C.H. Langford

Prerequisites: Chem. C211 previously, C315 concurrently

For: Optional course

Format: Lectures

Basis of Grading: Class test and final exam

Text: Skoug and West: Principles of Instrumental Analysis (2nd ed)
Saunders

Description: Topics in theory and application of electrochemical
methods involving voltammetry, potentiometry and conductance.
Introduction to solvent extraction and liquid chromatography

Chemistry C311 Introductory Analytical Organic Chemistry 2 credits

Instructor: R. Verschingel

Prerequisites: Chemistry C211 and C222 or Chem. C222 and 6 credits
in Biology courses with laboratory previously: Chem C316
concurrently.

For: Specialization programs in Analytical Chemistry

Format: Lectures

Basis of Grading: Final exam and computer problem

Text: Pasto and Johnson: Organic Structure Determination
(Prentice-Hall) and notes

Description: Identification of organic compounds by physical,
chemical and instrumental methods. Discussion of generalized
analytical procedures, and of the basic principles and
applications of relevant instrumentation. Use of data bases
in interpretation of spectra and identifying compounds.
Evaluation and use of computer and other data bases in
chemical analysis.

Chemistry C312 Intermediate Analytical Chemistry 3 credits

Instructor: TBA

Prerequisite: Chem. C211

For: All programs in Chemistry

Format: Lectures and laboratory

Basis of Grading: TBA

Text: TBA

Description: This course is a continuation of Chem. C211 with
emphasis on instrumental analysis. Techniques discussed
include emission spectroscopy; X-ray spectroscopy;
voltammetry and polarography, amperometric titrations;
coulometry and coulometric titrations; conductometry;
chromatography with particular emphasis on gas chromatography
and high performance liquid chromatography. Laboratory work
is done concurrently and provides experience in the
techniques discussed in lectures.

Chemistry C313 Environmental Pollution and
Pollutant Analysis

2 credits

Instructor: TBA

Prerequisites: Chem. C222 and any one of Chem. C211, C372, C373,
Biol. C250

For: Optional course

Format: Lectures

Basis of Grading: TBA

Text: TBA

Description: Scope and purpose of environmental chemistry; nature and composition of natural waters; pollution and trace-level substances in water; water analysis; nature and composition of the atmosphere; atmospheric levels of the oxides of carbon, sulphur and nitrogen; organic, inorganic and particulate pollutants in the atmosphere; monitoring and analysis of pollutants in the atmosphere.

Chemistry C314 Instrumental Analysis I: Optical Methods 2 credits

Instructor: R. Zienius

Prerequisites: Chem. C211 previously; Chem. C319 concurrently

For: Optional course

Format: Lectures

Basis of Grading: Midterm and final exams

Text: Skoog and West: Principles of Instrumental Analysis (2nd ed)(Saunders)

Description: Theory and application of absorptimetric, turbidimetric, nephelometric and fluorescence techniques; flame absorption and emission spectroscopy; electrical and plasma arc emission spectroscopy; atomic absorption flame and flameless techniques; X-ray fluorescence and diffraction methods; radiochemical techniques.

Chemistry C315 Electrochemical Methods of Analysis

Laboratory

1 credit

Instructor: C. Langford

Prerequisites: Chem. C211 previously; C310 concurrently

For: Optional course

Format: Laboratory

Basis of Grading: Laboratory work and reports, and 1 library report

Text: None

Description: Analytical experiments providing experience in the methods discussed in Chem. C310. Analysis of simple samples by voltammetry, potentiometry, coulometry and conductance.

Chemistry C316 Introductory Analytical Organic Laboratory 1 credit

Instructor: R. Verschingel

Prerequisites: Chem. C211 and C222 or 6 credits in Biology courses with laboratory; Chem. C311 concurrently.

For: Specialization in Analytical Chemistry

Format: Laboratory

Basis of Grading: Laboratory work, assignments and a computer analysis problem

Text: Notes

Description: Semimicro analytical methods, semimicro preparative methods, spectroscopic methods and computer-assisted data base searches used in identifying organic compounds.

Chemistry C319 Optical Methods of Analysis Laboratory 1 credit

Instructor: R. Zienius

Prerequisites: Chem. C211 previously; C314 concurrently

For: Optional course

Format: Laboratory

Basis of Grading: Laboratory work reports, oral tests

Text: No text

Description: Analytical experiments providing experience in the methods discussed in Chem. C314

Chemistry C321 Organic Stereochemistry 2 credits

Instructors: T. Adley, O. Tee

Prerequisites: Chem. C222 or equivalent; C232

For: Optional course

Format: Lectures

Basis of Grading: Assignments, midterm and final exams

Text: None

Description: Conformational analysis of acyclic and cyclic systems. Relationship to physical properties and chemical reactivity: Chirality, enantiomerism, diastereomerism, prochirality, enantiotopism, and diastereotopism. Examples from steroid, carbohydrate, and enzyme mediated reactions.

Chemistry C322 Organic Reactions 2 credits

Instructor: TBA

Prerequisites: Chem. C321 and C331 previously or concurrently

For: Optional course

Format: Lectures

Basis of Grading: Midterm and final exams

Text: None

Description: A mechanistic survey of reactions of major synthetic utility. Determination of reaction mechanisms. Importance of reactive intermediates: Carbocations, carbanions, radicals, and carbenes.

Chemistry C323 Bio-Organic Chemistry

2 credits

Instructor: T. Nogrady

Prerequisite: Chem. C321

For: Optional course

Format: Lectures

Basis of Grading: Assignments, midterm and final exams

Text: None

Description: Chemistry of carbohydrates. Aspects of heterocyclic chemistry, particularly as they apply to purines, pyrimidines, and important coenzymes: pyridoxal, NADH, thiamine, flavines. Model enzyme studies.

Chemistry C324 Organic Chemistry III: Organic Reactions 3 credits

Instructor: TBA

Prerequisite: Chem. C222 or equivalent, Chem. C331 previously or concurrently

For: All programs in chemistry

Format: Lectures and laboratory

Basis of Grading: TBA

Text: TBA

Description: This course is a mechanistic survey of reactions of major synthetic utility. It deals with reaction mechanisms and the importance of reactive intermediates such as carbocations, carbanions, radicals and carbenes

Chemistry C325 Organic Chemistry IV: Organic Structure
and Stereochemistry 3 credits

Instructor: TBA

Prerequisite: Chem. C334 and Chem. C233 previously or concurrently

For: All programs in chemistry

Format: Lectures and laboratory

Basis of Grading: TBA

Text: TBA

Description: The course examines organic structure and stereochemistry including the relationship of stereochemistry to physical properties and chemical reactivity. The use of chemical and spectroscopic means to determine structure and stereochemistry is included. The laboratory work involves the identification of organic compounds.

Chemistry C326 Natural Products

2 credits

Instructor: TBA

Prerequisite: Chem. C222 or equivalent

For: Optional course

Format: Lectures

Basis of Grading: Tests and final exam.

Text: TBA

Description: Structure determination, synthesis, and stereochemistry of various natural products. Examples from terpenes, carotenoids, steroids, alkaloids, and antibiotics.

Chemistry C328 Organic Chemistry of Polymers

2 credits

Instructor: R. Pallen

Prerequisites: Chem. C222 or equivalent; C232

For: Optional course

Format: Lectures

Basis of Grading: Midterm and final exams

Text: Lenz: Organic Chemistry of Synthetic High Polymer (Inter-science)

Description: Introduction to the fundamental aspects of polymers and polymerization. Methods of preparation, reaction mechanisms of polymer synthesis including condensation polymerization; addition polymerization: free radical, anionic, cationic; Ziegler-Natta (heterogeneous) polymerization.

Chemistry C329 Organic Reactions Laboratory

1 credit

Instructor: L. Colebrook

Prerequisites: Chem. C322 or C323 previously or concurrently; C331; C332 previously or concurrently.

For: Optional course

Format: Laboratory

Basis of Grading: Laboratory work and reprints

Text: TBA

Description: Experiments with reactions of synthetic and mechanistic importance. Reactions involving reactive intermediates. Kinetic and thermodynamic control.

Chemistry C331 Physical Chemistry III: Kinetics

2 credits

Instructors: D. McElcheran, R.T. Rye

Prerequisites: Chem. C233

For: All programs

Format: Lectures

Basis of Grading: Midterm, final exam and assignments.

Description: Kinetic molecular theory. Topics in chemical-reaction kinetics, including: mechanisms of elementary reactions; theories of chemical reaction rates; free-radical reactions; factors influencing rates of reactions in solution; acid-base catalysis; catalysis by enzymes; the Michaelis-Menten mechanism; inhibition in enzyme-catalyzed reactions.

Chemistry C332 Physical Chemistry IV: Thermodynamics 2 credits

Instructor: R.A. Westbury

Prerequisite: Chem. C233

For: All programs in chemistry

Format: Lectures

Basis of Grading: Midterm and final exams

Text: TBA

Description: Comparison of closed and open systems, partial molal quantities, chemical potential, real gases, fugacity, equilibrium constant, free energy function ideal solutions, real solution, Duhem-Margules equation.

Chemistry C334 Intermediate Physical Chemistry II 2 credits

Instructor: D. McElcheran

Prerequisite: Chem. C331

For: Optional course

Format: Lectures

Basis of Grading: Assignments, midterm and final exams

Text: Same as Chem. C232

Description: The molecular properties of matter, and an introduction to chemical spectroscopy.

Chemistry C335 Physical Chemistry of Polymers 2 credits

Instructor: R.E. Townshend

Prerequisites: Chem. C222; C233

For: Optional course

Format: Lectures

Basis of Grading: Midterm and final exams

Text: Billmeyer: Textbook of Polymer Chemistry
(Wiley-Interscience)

Description: Physical properties of polymers; polymer solution theory; molecular weight distributions and fractionation; molecular weight determinations by colligative properties, light scattering and ultra-centrifuge techniques; kinetics of condensation and addition polymerizations; copolymerization.

Chemistry C338 Physical Chemistry Laboratory I

2 credits

Instructor: D. McElcheran

Prerequisite: Chem. C233

For: All programs in Chemistry

Format: Laboratory

Basis of Grading: Laboratory work and reports

Text: McElcheran: Lab Manual for Physical Chemistry

Description: Experiments in physical chemistry to illustrate some of the concepts studied previously, and to acquire basic dexterity in the physical chemistry laboratory.

Chemistry C339 Physical Chemistry Laboratory II

2 credits

Instructor: D. McElcheran

Prerequisite: Chem. C233

For: All programs in Chemistry

Format: Laboratory

Basis of Grading: Laboratory work and reports

Description: Further experiments in physical chemistry. The student will be expected to investigate more complex systems and to write meaningful laboratory reports.

Chemistry C341 Inorganic Chemistry III: The Transition Elements

3 credits

Instructor: TBA

Prerequisites: Chem. C211, Chem. C241, Chem. C242

For: All programs in Chemistry except Biochemistry

Format: Lectures and laboratory

Basis of Grading: TBA

Text: TBA

Description: This course covers theories of bonding in transition metal complexes including ligand field theory and their application to structure, physical properties and reactivity. Other topics include organometallic chemistry, catalysis and metals in biological systems.

Chemistry C342 The Transition Elements

2 credits

Instructor: P.H. Bird

Prerequisites: Chem. C211, C241, C242

For: Optional course

Format: Lectures

Basis of Grading: Assignments, midterm and final exams.

Text: Huheey: Inorganic Chemistry (Harper and Row)

Description: Coordination chemistry; structure, theory of bonding, reactivity of transition metal complexes of various

coordination numbers. Descriptive chemistry of transition metals of various oxidation states. Organometallic chemistry. Inorganic chemistry in biological systems.

Chemistry C348 Inorganic Chemistry Laboratory

1 credit

Instructor: P.H. Bird

Prerequisite: Chem. C342 previously or concurrently

For: Optional course

Format: Laboratory

Basis of Grading: Laboratory work and reports

Text: Angelici: Synthesis and Technique in Inorganic Chemistry (Saunders)

Description: Synthesis of coordination and organometallic compounds requiring various techniques. Determination of various properties of the compounds prepared at the laboratory bench.

Chemistry C372 Introductory Biochemistry I

3 credits

Instructors: T. Nogrady, S. Shapiro

Prerequisites: Chem. C222 and for students in a Biochemistry program, Chem. C232

For: Optional course

Format: Lectures and laboratory

Basis of Grading: Lab work, midterm and final exams

Text: TBA

Description: Thermodynamics and the role of ATP; structure and function of proteins and nucleic acids including protein structure, enzymology, replication of DNA, transcription and translation of DNA.

Chemistry C373 Introductory Biochemistry II

3 credits

Instructors: J. Fraser, J. Kornblatt, T. Nogrady

Prerequisite: Chem. C372

For: Optional course

Format: Lectures and laboratory

Basis of Grading: Laboratory work, midterm and final exams

Text: TBA

Description: Intermediary metabolism, including biosynthesis and degradation of carbohydrates, lipids and amino acids; bioenergetics and photosynthesis.

Chemistry C374 Macromolecular Synthesis

3 credits

Instructors: TBA

Prerequisite: Chem. C271

For: Specialization in Biochemistry

Format: Lectures and problem sessions

Basis of Grading: TBA

Text: TBA

Description: This course deals with the synthesis of proteins, nucleic acids, lipids and the synthesis and assembly of complex structures such as membranes, ribosomes, etc.

Chemistry C375 Intermediary Metabolism

3 credits

Instructor: TBA

Prerequisite: Chem. C271

For: Specialization in Biochemistry

Format: Lectures and laboratory

Basis of Grading: TBA

Text: TBA

Description: This course surveys selected pathways in intermediary metabolism including their regulation and physiological significance; the urea cycle; fatty acid oxidation; biosynthesis of nucleosides, tetrapyrroles, carotenoids, cholesterol and steroidal hormones. The biosynthesis of vitamins and cofactors and the metabolism of selected aminoacids may also be discussed.

Chemistry C380 Structure of the Chemical Industry

2 credits

Instructor: TBA

Prerequisites: Second year standing in a chemistry program of permission of the Department

For: Optional course

Format: Lectures

Basis of Grading: TBA

Text: TBA

Description: Broad outline of major factors to be considered by the chemical industry when contemplating manufacture of a new product of product group. Among the topics that are discussed are: Chemical patents; economic analysis of a process; scale-up of a laboratory reaction to a pilot-plant size process; using kinetic rate constants to design a chemical process reactor; heat transfer and removal of a large-scale chemical reactor; chemical transport considerations; hazard and pollution considerations; material accounting and mass balances.

Chemistry C389 Industrial Chemical Laboratory

1 credit

Instructor: TBA

Prerequisites: Chem. C222, C232, C380, previously or concurrently

For: Optional course

Format: Laboratory

Basis of Grading: Laboratory work and reports

Text: TBA

Description: A course designed to provide the student with an understanding of the philosophies of industrial quality control, and of industrial research and development. Common industrial techniques will be studied, including laboratory safety; measurement of physical properties; synthetic procedures, both organic and inorganic; and various separation techniques. Several instrumental analytical methods will be employed, and a final report on the work of the term will be submitted.

Chemistry C390 Introductory Instrumentation

2 credits

Instructor: R. Verschlingel

Prerequisites: Chem. C211 or two 6 credit Biology laboratory courses previously; Chem. C399 concurrently

For: Specialization in Analytical Chemistry

Format: Lectures

Basis of Grading: 1 written exam and a practical test

Text: References given

Description: Introduction to measurement principles. Instrument design and basic techniques; analysis of amplifiers, impedance matching circuits, integrators, differentiators, comparators, filter circuits and other basic modules used in pH meters, potentiometric titrators, polarographs, gas chromatographs, photometers and spectrophotometers to emphasize facility in the use of similar instruments for measurement of specific systems.

Chemistry C391 Chemical Spectroscopy and Analysis

3 credits

Instructor: T.J. Adley

Prerequisites: Chem. C222, C232

For: Optional course

Format: Lectures, problem periods, laboratory

Basis of Grading: TBA

Text: TBA

Description: General theories of spectroscopy. Infrared, ultraviolet, proton magnetic resonance spectroscopies and mass spectrometry will be applied to the elucidation of the structure of organic molecules. Rates and activation energies by pmr.

Chemistry C397 Introductory Instrumentation Laboratory 1 credit

Instructor: R. Verschingel

Prerequisites: Chem. C211 or two full laboratory courses in Biology previously; Chem. C390 concurrently

For: Optional course

Format: Laboratory

Basis of Grading: Lab exam in the laboratory

Text: See Chem. C390

Description: Basic RLC circuits, filters, semi-conductors, transistors, and basic IC circuits used in instrumentation. Derivation of equivalent circuits to analyze properties, performance and estimate error. Introduction to mechanical, optical and electrical transducers and recorders; signal-to-noise optimization, digital electronics, logic circuits and automation.

Chemistry C398 Selected Topics in Chemistry 3 credits

Details to be supplied later.

Chemistry C399 Selected Topics in Chemistry 6 credits

Details to be supplied later.

Chemistry C419 Independent Study and Practicum 6 credits

Instructor: The Faculty

Prerequisites: A grade of C- or better in 31 credits of the core program, acceptance by a supervisor, confirmation by the Department

For: Specialization in Chemistry and Analytical Chemistry

Format: Laboratory and conferences

Basis of Grading: Written report of laboratory and oral examination by a committee of Department members

Text: None

Description: The student will carry out independent study and practical work on a problem from the area of the student's concentration. The work will be done in collaboration with and under the direction of a member of Faculty.

Chemistry C421 Physical Organic Chemistry 3 credits

Instructor: O.S. Tee

Prerequisite: Chem. C322

For: Optional course

Format: Lectures

Basis of Grading: Assignments and final exam

Text: None

Description: Determination of organic reaction mechanisms using kinetics, activation parameters, acid-base catalysis, Bronsted catalysis law, solvent effects, isotope effects, substituent effects and linear free energy relationships.

Chemistry C422 Organic Synthesis

4 credits

Instructor: L.D. Colebrook

Prerequisite: Chem. C322

For: Optional course

Format: Lectures and laboratory

Basis of Grading: Assignments, final exam and lab work

Text: None

Description: Consideration of synthetic strategy and synthesis design. Modern synthetic methods and reagents, exemplified by syntheses of terpenes, alkaloids, pheromones, and novel structures.

Chemistry C431 Statistical Thermodynamics

3 credits

Instructor: R.E. Townshend

Prerequisites: Chem. C3312, C334

For: Optional course

Format: Lectures

Basis of Grading: Midterm and final exams

Text: Andrews: Equilibrium Statistical Mechanics (Wiley)

Description: Elements of probability theory, microcanonical, canonical, and grand canonical ensembles; Boltzmann distribution; quantum mechanical treatment of an ideal gas; Fermi-Dirac and Bose-Einstein statistics; Einstein and Debye models of monatomic crystal; conformation of polymer chains.

Chemistry C433 Advanced Quantum Chemistry

3 credits

Instructor: R.E. Townshend

Prerequisites: Chem. C233, C334

For: Optional course

Format: Lectures

Basis of Grading: TBA

Text: TBA

Description: This course deals with the theories of valence for both organic and inorganic materials. Topics covered include symmetry, construction and use of character tables, valence bond theory, molecular orbital theory, crystal field theory, ligand field theory.

Chemistry C434 Advanced Physical Chemistry forBiochemists

3 credits

Instructor: K. Ekler

Prerequisite: Chem. C333

For: Optional course

Format: Lectures

Basis of Grading: Midterm and final exams

Text: None

Description: Thermodynamics applied to biological systems. Surface tension. Capillarity. Surface thermodynamics. Surface films. Adsorption. Electrocapillarity. Electrokinetic effects. Transport properties. Light scattering, Zimm plot.

Chemistry C439 Advanced Physical Chemistry Laboratory 3 credits

Instructor: R.T. Rye

Prerequisites: Chem. C331, C334, C339

For: Optional course

Format: Lectures and laboratory

Basis of Grading: TBA

Text: TBA

Description: Advanced experimentation in chemical kinetics and thermodynamics, with complete laboratory reports.

Chemistry C442 Physical Methods in Inorganic Chemistry 3 credits

Instructor: P.H. Bird

Prerequisites: Chem. C241, C242, C211 previously, 391 previously or concurrently

For: Optional course

Format: Lectures

Basis of Grading: Assignments

Text: Drago: Physical Methods in Chemistry (Saunders)

Description: Introduction to symmetry and the character tables. Diffraction methods, X-ray, ESCA, UV-Visible, ORD and CD, EPR, Moessbauer, NQR, NMR, IR, and Raman.

Chemistry C449 Laboratory in Synthesis and Techniques
in Inorganic Chemistry

1 credit

Instructor: P.H. Bird

Prerequisite: Chem. C442 previously or concurrently

For: Optional course

Format: Laboratory

Basis of Grading: Laboratory work and reports

Text: Angelici: Synthesis and Technique in Inorganic Chemistry (Saunders)

Description: Some of the techniques discussed in Chem. C442 will be employed in the laboratory to characterize and determine properties of compounds synthesized at the laboratory bench.

Chemistry C450 Research Project and Thesis 6 credits

Instructor: The Faculty

Prerequisite: Third year standing in Honours Chemistry or permission of the Department, 60 credits in Chemistry

For: Honours program or students with permission

Format: Laboratory and conference

Basis of Grading: Written thesis and its oral defence before the faculty

Text: None

Description: The student will work on a research project selected in consultation with and conducted under the supervision of a faculty member of the Department and will write a thesis on the results. The project will also be the subject of a seminar before the Department.

NOTE: Students planning to take this course must consult with the Chemistry Department as early as possible the year before the final year.

Chemistry C471 Enzyme Kinetics and Mechanism 3 credits

Instructor: M.J. Kornblatt

Prerequisites: Chem. C271; 60 credits in Chemistry

For: Optional course in Biochemistry programs

Format: Lectures

Basis of Grading: Midterm, final exams, and assignments. (No supplementals allowed in this course)

Text: Fersht: Enzyme Structure and Mechanism (Freeman)

Description: Steady state kinetics, including the use of initial velocity studies and product inhibition to establish a kinetic mechanism; non-steady-state kinetics, isotope effects, energy of activation, etc; detailed mechanisms of selected enzymes.

Chemistry C473 Medicinal Chemistry I 3 credits

Instructor: TBA

Prerequisites: Chem. C271, 60 credits in Chemistry

For: Required for Medicinal Chemistry Option in Biochemistry Specialization

Format: Lectures

Basis of Grading: Midterm and final exams

Text: TBA

Description: Physiochemical principles of drug action. Influence of solubility, surface phenomena, stereochemistry and electronic properties on drug action. Nonspecific drugs, anaesthetic, membrane-active disinfectants and antibiotics. Quantitative structure-activity relationships. Receptor theory and models, methods of receptor characterization.

Chemistry C474 Medicinal Chemistry II 3 credits

Instructor: TBA

Prerequisites: Chem. C473 or permission

For: Required for Medicinal Chemistry Option in Biochemistry Specialization

Format: Lectures

Basis of Grading: Term paper and final exam

Text: TBA

Description: Drugs acting on endogenous messengers and their targets: cholinergic, adrenergic, dopaminergic and serotonergic neuronal systems. Histamine, amino acid neurotransmitters. Steroid and peptide hormones, prostaglandins. Enzymes as drug receptors. Drug design.

Chemistry C475 Pharmacology I 3 credits

Instructor: T. Nogrady

Prerequisites: Chem. C271, Biol. C333

For: Required for Medicinal Chemistry Option in Biochemistry Specialization

Format: Lectures

Basis of Grading: Midterm and final exams

Text: Seeman, Sellers and Roschlau: Principles of Medicinal Pharmacology 3rd Ed. (U. of Toronto)

Description: Topics discussed include: Pharmacokinetics, drug metabolism and interaction. Toxicology, carcinogeneticity, and teratogeneticity. Drug development and testing.

Chemistry C476 Pharmacology II 3 credits

Instructor: T. Nogrady

Prerequisite: Chem. C475 or permission

For: Optional course

Format: Lectures

Basis of Grading: Project, midterm and final exams

Text: Seeman, Sellers and Roschlau: Principles of Medicinal Pharmacology 3rd Ed. (U. of Toronto)
 Description: Autonomic nervous system pharmacology. Functions of central nervous system, depressants, stimulants. Narcotic analgesics, addition. Cardiovascular, renal, and endocrine pharmacology.

Chemistry C479 Advanced Biochemistry Laboratory 3 credits

Instructor: J. Fraser, J. Kornblatt
 Prerequisites: Grade C- or better in 31 core credits
 For: Specialization in Biochemistry, Major in Biochemistry
 Format: Laboratory
 Basis of Grading: Laboratory work and reports, final exam
 Text: Cooper: Tools of Biochemistry
 Description: This course deals with the theory and practice of modern biochemical laboratory techniques.

Chemistry C490 Advanced Instrumentation 3 credits

Instructor: R. Verschingel
 Prerequisites: Chem. C390, C397 previously, C497 concurrently
 For: Optional course
 Format: Lectures
 Basis of Grading: Written final exam
 Text: Library references
 Description: Instrumental amplifiers, transducers, and measurement errors. Analog, time, and digital data domains. Optimization of electronic measurements, frequency response, sampling parameters, signal-to-noise enhancement and budget error analysis. Micro-processors for control, data acquisition and interface to computers.

Chemistry C492 Chemical Spectroscopy 4 credits

Instructor: L.D. Colebrook
 Prerequisites: Chem. C321, 311, and C316, or C391
 For: Optional course
 Format: Lectures and Laboratory
 Basis of Grading: Midterm and final exams, laboratory work
 Text: TBA
 Description: Theory and application of EPR Spectroscopy, rotational spectroscopy, rotation-vibrational spectroscopy, Raman spectroscopy.

Chemistry C497 Advanced Instrumentation Laboratory 1 credit

Instructor: R. Verschingel

Prerequisites: Chem. C390, C397 previously Chem. C490 concurrently

For: Optional course

Format: Laboratory

Basis of Grading: Assignments

Text: See Chem. C490

Description: Selected experiments to demonstrate the topics discussed in Chem. C490.

Chemistry C498 Advanced Topics in Chemistry 3 credits

Details to be supplied in future

Chemistry C499 Advanced topics in Chemistry 6 credits

Details to be supplied later.